

The Awareness and Benefits of BIM in the Construction Industry of Saudi Arabia

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Abstract

Due to the high demand for infrastructure projects and their large sizes a huge deal of construction opportunities have materialised in the construction market of Saudi Arabia. Building Information Modelling (BIM) is a relatively new technology which is used to support construction business processes. BIM is currently used by construction professionals globally on all types of construction projects to avoid or minimise costly delays and change requests, amongst other benefits. However the use of BIM in Saudi Arabia is still emerging. Given the relatively low level by which BIM is used in Saudi Arabia, a research to investigate its awareness and benefits, amongst other considerations, was conducted. A questionnaire survey was carried out. A total of 342 people were approached to complete the questionnaire and 224 full responses were collected, representing a response rate on 65%. The data was analysed using descriptive statistics where, it was found that more respondents opined that the awareness of BIM in Saudi Arabia is growing. Most respondents agreed that BIM offered many benefits e.g. it makes it easier to develop and manage projects and information quickly. It also helps in linking different activities and stakeholders in the project and gives better and advanced information about the project throughout its life-cycle.

Keywords

Awareness, Benefits, Building Information Modelling, Construction, Saudi Arabia

1. Introduction

Over the last decade, Building Information Modelling (BIM), as an integrated design and delivery approach, has become a solution for the delivery of construction projects and its use is being advocated by both clients and in some cases, the government (McGraw-Hill, 2012). In the United Kingdom, the use of BIM on major Government construction projects has been made mandatory as from 2016 (BIM Task Group, 2013). In Europe, the implementation of BIM gradually increased from 2007, and surged after 2010 (McGraw-Hill, 2010). BIM is being used in many developed countries, given its many benefits such as accuracy of designs, real time analysis for design justification, better service provision, greater building performance, smooth design process and delivery, project time savings, improved quality of projects and money savings (Eastman, Teicholz, Sacks, and Liston, 2011; Hardin, 2009).

Saudi Arabia, is the largest economy in the Middle East (Alhowaish, 2015) and plans to generate construction

contracts to the value of more than one trillion US Dollars in the next five years (Deloitte, 2014). The Kingdom of Saudi Arabia (KSA) will build more than two million houses, develop airports and train stations, and build 11 big stadiums (Al-Arabiya-News, 2014). However, most of KSA's indigenous construction companies lack the knowledge and management experience of delivering big projects (Jannadi, 1997), necessitating a capacity development plan (Almsheeti, 2014). Meanwhile, many foreign construction companies in partnership with local firms deliver projects in KSA as either consultants or contractors. BIM is seen as the next concept which will revolutionize the KSA construction industry being partly imported by these foreign companies.

Since not all operators in the KSA construction sector are implementing BIM, a research was carried out to, partly investigate its level of awareness in the country as well as its perceived benefits. This article reports some of the findings of this research. The next section provides a literature review and is followed by the methodology employed in the research. Findings are then presented and discussed before the paper is concluded.

2. Literature Review

BIM is an improvement on the traditional CAD-design approach to projects (Eastman *et al.*, 2011). "The key benefit of BIM is its accurate geometrical representation of the parts of a building in an integrated data environment" (Azhar *et al.*, 2008). The benefits of BIM include the minimisation of errors, and better management of quality, budget and time: BIM was used to aid facility management on the Sydney Opera House project (Sabol, 2008). The numerous benefits of BIM are discussed by authors such as Balish and Sullivan (2008), Eastman *et al.*, (2011) and Reddy (2011).

Wang and Chien (2014), conducted a quantitative and qualitative questionnaire survey to find out the awareness of BIM in the Australian construction industry; it was found that 39% of the total respondent were aware and using BIM in their firms, 41% were aware of BIM but not using it, and 20% had not heard what BIM is (Wang and Chien, 2014). A survey conducted by Smart Market Report shows that the rate of BIM adoption and level of experience of using it in North America had increased from 28% in 2007 to 71% percent in 2012; BIM is growing rapidly in New Zealand, where it has shown a steep increase from 34% in 2012 to 57% in 2013, and its unawareness has declined from 12% in 2012 to 2% in 2013 (Jones and Berstein, 2012). The Kingdom of Saudi Arabia is one of the prevalent countries in the Middle East and has the largest and rapidly growing construction sector (Deloitte, 2014), it is leading the Middle Eastern countries in the value of their projects (see Figure 1).

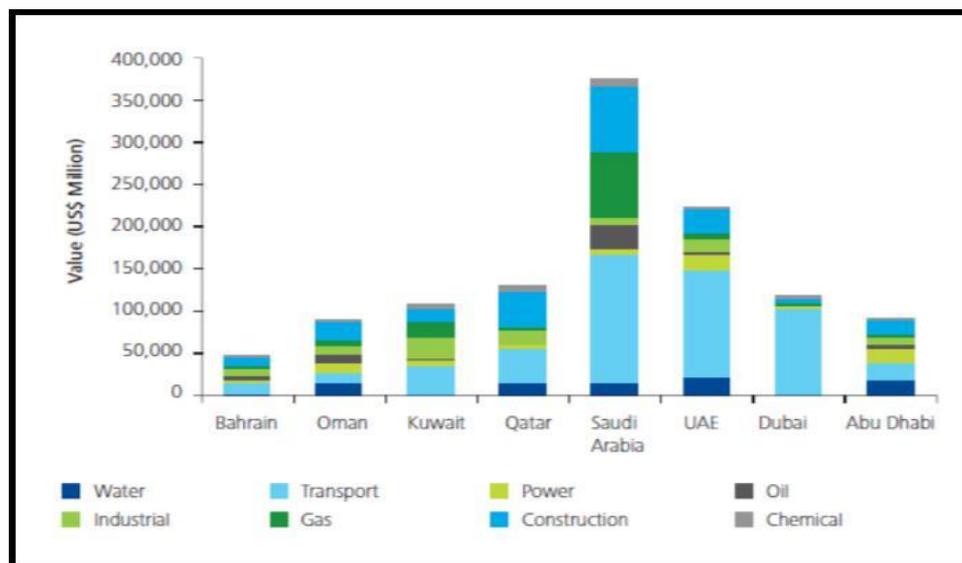


Figure 1: Value of projects (all sectors) in Middle Eastern countries in the period 2014 to 2020 (Source: Deloitte, 2014)

However the use of BIM in the Gulf Co-operation Council Countries and Jordan is low when compared with Western Europe and the United States (see Figure 2) but there is a growing awareness of its significant benefits (Building SMART in the Middle East, 2011).



Figure 2: A BIM usage comparison between GCC, Western Europe, and US

(Source: BuildingSmart ME, 2011)

BIM is still an emerging technology as far as Saudi Arabia is concerned. Not many companies have used it due to the lack of qualified professionals and awareness (Kazi, 2005; Alsahli, 2011). Hence a research investigated the current level of awareness of BIM in KSA and explored factors which can enhance its wide implementation in the country.

3. Research Methodology

A quantitative study was carried out amongst Contractors, Builders, Site Engineers, Design Engineers and Project Managers, by means of a questionnaire survey. The questionnaire survey was posted on the internet using a web based platform. The questionnaire was also distributed personally by hand at live construction projects where site visits were conducted. A total of 342 people were approached for data and 224 completed questionnaires were obtained, representing a response rate of 65%. From these responses, 185 questionnaires were analysed as these respondents fully completed the sections regarding the awareness and benefits of BIM. All the questions were specifically aimed at studying the awareness of BIM.

A five-category Likert scale was mostly used in the questionnaire, being informed by the discussions of Stening and Everett (1984) and Wong *et al.*, (2011). EXCEL was used to collate the data collected while the SPSS tool was used for the analysis where descriptive statistics were computed. The 224 respondents included 44 project managers, 10 construction managers, 34 directors, 29 architects, 26 civil engineers, 20 planning team members, 1 quantity surveyor, 4 safety managers, 6 lecturers, 11 engineers; whereby 64 respondents had less than 5 years of experience, 56 respondents had 6-10 years of experience, 41 respondents had 11 to 15 years of experience, 24 respondents had 16 to 20 years of experience, 16 respondents had 21 to 25 years of experience and 23 respondents had more than 25 years of experience; 69 respondents worked in the public sector, 43 respondents worked in the private sector and 112 worked in both sectors; whilst 77 respondents have worked on small and medium sized projects (worth 1-50 million Saudi Riyals), 56 respondents have worked on large projects (worth 51-250 million Saudi Riyals) and 91 respondents have worked on mega projects (worth +250 million Saudi Riyals).

4. Findings and Discussions

The rating of the level of awareness and benefits of BIM by the respondents to the questionnaire survey is shown in Table 1, where it can be observed that 39% of the respondents agreed that there is growing awareness of BIM in KSA and 10% of the respondents agreed strongly with the statement. With 49% agreement, the results suggest that there is a slow but gradual growing awareness of BIM in KSA. The demand for BIM usage in KSA is also growing according to majority of the respondents with 39% of the respondents agreeing and 9% strongly agreeing respectively with this aspect.

Table 1: Response Percentages Regarding Awareness and Benefits of BIM in the Saudi Arabian Construction Industry

Awareness and Benefits of BIM	Rating by the respondents				
	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)
There is growing awareness of BIM in KSA	8	21	22	39	10
There is growing demand for BIM usage in KSA	5	17	30	39	9
The usage of BIM will shorten the overall project time scale	0	2	17	53	28
The use of BIM reduce the overall project cost	1	5	21	47	26
The use of BIM minimises construction conflict	0	2	20	52	26
The use of BIM makes information more accessible to project team members	0	9	15	54	29
The use of BIM can improve the design of a building	0	3	10	48	39
The use of BIM makes communication more straightforward	0	0	16	52	32
The use of BIM makes project scheduling easier	0	2	13	56	29
Full project life cycle evaluations can be conducted using BIM	0	2	25	46	26
A real time model of the project can be visualized with the use of BIM	0	2	22	55	21

Many respondents agreed that BIM shortens the overall project time scale (53%), reduces the cost (47%) and minimizes construction conflicts (52%). None of the respondents disagreed strongly with the facts that the use of BIM makes information more accessible to project team members; communication more straightforward and project scheduling easier. Majority of the respondents actually agreed with all these benefits of BIM i.e. it makes information more accessible to project team members (54%), makes project scheduling easier (56%), improves the design of a building (48 %), makes communication more straightforward (52%), and enhances both full project visualization as a real time model (55%) and life cycle evaluations (46%).

Furthermore according to the results of survey, 28% of the respondents strongly agreed that the usage of BIM shortens the overall project time scale. Similarly 26% strongly agreed, that the usage of BIM lessens the cost of project and 26% strongly agreed that BIM minimizes the project conflict whereas 29% strongly agreed that the use of BIM makes information more accessible to project team members. These positive ratings are similar to the one in which 39% of the respondents strongly agreed that the use of BIM makes project scheduling easier, and 32% strongly agreed that the use of BIM can improve the design of a building while 32% strongly agreed that the use of BIM makes communication more straightforward. According to the survey 26% of the respondents strongly agreed that full project life cycle evaluations can be conducted using BIM and 21% strongly agreed that a real time model of the project can be visualized with the use of BIM respectively.

The assessments of the respondents were not unanimous, as some fewer respondents rated constructs in both the neutral and 'disagree' categories. In this regard, it can be observed that the respondents who rated strongly disagree and disagree are not homogenous; their construction backgrounds include a college or Bachelors level of education, wide range of work experience in the construction industry of Saudi Arabia of between 1 to over-25 years, and working as consultants, contractors, project managers, architects, and engineers. These respondents have also worked in both the public and private sectors on all types of construction projects (small, medium, large and mega projects). However the majority of these respondents have either not attended any BIM training sessions or have only attended a few training sessions. Also, the majority of them have not developed any projects using BIM. The few respondents who have developed projects using BIM have done so on only between 1-5 projects. This may suggest that they still have a lot to learn or that they have been working with traditional methods for so long that they need to professionally develop themselves to bring them up-to-date with innovative new working methods in the construction industry of Saudi Arabia. Thus it can be hypothesise that the low awareness of BIM is associated with the low amount of training on it, and vice-versa.

There is also some ratio of respondents who were neutral, maybe because they were not familiar with the BIM or they do not know the advantages or disadvantages of BIM. However there is a greater loading of the positive perception of BIM and the benefits it offers as Table 1 shows that the majority of respondents find BIM useful and beneficial and very few respondents of the survey find BIM impractical and ineffective.

In the survey a provision was made for suggestions regarding the awareness and benefits of BIM. Most of the respondents made suggestions on both issues. They suggested that the awareness of BIM is currently too low; therefore more efforts such as training and academic educational courses are needed through which the level of awareness amongst construction professionals within KSA can be increased. Nevertheless in general there is a gradual growing demand for BIM. The benefits of BIM are generally known i.e. it allows for developing the project faster and helps to increase workability, which in turn will lead to less paperwork, reduce time and cost, improve quality and coordination, 3D visualization, quick identification of materials and minimization of construction conflicts and change orders.

In general the survey findings show a slow but gradual growing demand for BIM as some construction organizations in KSA are showing interest in the use of BIM software's and aspire that their construction personnel should be informed about the uses and advantages of BIM. The respondents who do not know

much about BIM have shown an interest in learning about this technology as they believe that it will be part of the future delivery of project management in Saudi Arabia. As a result the respondents believe that BIM will be more productive and a professional method for managing construction projects. Consequently the researchers foresee a greater adoption of BIM in KSA. Other issues were explored in the questionnaire survey which supports this position but their discussion is outside the scope of the present paper.

5. Conclusion

The conclusions drawn from the survey are based on the awareness and benefits of BIM adoption. Through the survey data it was found that the awareness of BIM is slowly increasing among the construction professionals in Saudi Arabia. Figure 2 and Table 1 support this upward trend. Nevertheless in general the level of BIM awareness in Saudi Arabia is still low. This can be attributed to the fact that several survey respondents have few or no training regarding BIM as they have not updated themselves with any professional development regarding BIM nor have they attended any BIM training sessions or developed any projects using BIM. This low BIM training may explain their low awareness of BIM and its benefits. These findings show that a knowledge-gap exists regarding the awareness of BIM within the construction industry of the Kingdom of Saudi Arabia.

Overall, it can be concluded from the survey results presented that the use of BIM makes information more accessible and at the same time helps to improve the design of buildings and other facilities. Its generic benefits which are also applicable to KSA include the improvement of communication amongst project team members, the ease of the scheduling of project activities as well as Project Life Cycle costings. The results of this survey clearly reflect that BIM also provides a platform for integrated processes built on coordinated reliable information and resulting in enhanced coordination, fewer requests for clarification and change orders, and less need for rework. Moreover BIM models can be linked to scheduling software enabling better communication between contractors and other project participants. Hence the adoption of BIM ensures savings in 'time, money and effort' (Vogt, 2010). While the awareness of BIM in the country is lower, the understanding of its benefits by users is contrastingly quite high.

Based on the trends observed by the results of the questionnaire survey, it can be concluded that the construction terrain of KSA is fairly ready for a complete push to implement BIM in all its segments and increase the level of its usage. A greater effort is needed to increase its awareness in the country. This greater effort may need to involve construction practitioners, professional bodies and Government.

The results presented in the foregoing sections are part of the preliminary findings of the research. More analysis will be carried out on other aspects of the research where other means of increasing the use of BIM in the Kingdom of Saudi Arabia will be evaluated.

6. References

- Al-Arabiya-News., (2014), Saudi king orders building of 11 new stadiums. [Available online] (Accessed 11/10/2016) @ <http://english.alarabiya.net/en/sports/2014/06/22/Saudi-Arabia-kings-orders-11-new-stadiums-across-the-kingdom.html>
- Almsheeti, M. (2014). 11 thousand Saudi engineer certified Kingdom, including 500 women. [Available online] (Accessed online 11/10/2016) @ <http://www.alhayat.com/Articles/3362516>
- Alsahli, A., (2011), *A Framework for Successful Implementation of IT for Construction Organizations in Saudi Arabia*. PhD thesis, University Of Salford, UK.
- Alhawaish, A. K. (2015), Causality between the Construction Sector and Economic Growth: The

- Case of Saudi Arabia. *International Real Estate Review*, 18(1), 131-147.
- Azhar, S., Hein, M., Sketo, B., (2008), "Building Information Modelling: Benefits, Risks and Challenges", *Proceedings of The 44th ASC National Conference*, Auburn, Alabama, USA, p2-5
- Azhar, S., Khalfan, M., and Maqsood, T., (2012), Building Information Modelling (BIM): Now and beyond. *Australasian Journal of Construction Economics and Building*, 12, p15
- Barlish, K., and Sullivan, K., (2012), How to measure the benefits of BIM - A case study approach. *Automation in Construction* 24, p149–159.
- BIM Task Group, B., (2013), *Embedding Building Information Modelling (BIM) within the taught curriculum*. BIM Related Reports1. BIM Taskgroup. London: HMSO.
- BuildingSMART Middle East., (2011), "BIM in the Middle East (2011): The Reality and The Way Forward". Building SMART ME. [Available online] (Accessed online 11/10/2016) @ <http://www.bimjournal.com/wp-content/uploads/2011/05/Full-BIM-Report-Web.pdf>
- Deloitte., (2014), *Deloitte GCC Powers of Construction 2014 Construction sector overview. Middle East*. Deloitte.
- Eastman, C., Teicholz, P., Sacks, R., and Liston, K. (2011), *BIM handbook: A guide to building information modelling for owners, managers, architects, engineers, contractors, and fabricators*: Hoboken, NJ: John Wiley and Sons.
- Hardin, B., (2009), *BIM and construction management: Proven tools, methods, and workflows*: Indianapolis, John Wiley and Sons.
- Jannadi, M. O., (1997), Reasons for construction business failures in Saudi Arabia. *Project Management Journal*, 28(2), p32-36.
- Jones, S.A., and Berstein, H.M., (2012), "The Business Value of BIM in North America" *SmartMarket Report*, McGraw Hill Construction.
- Kazi, A. S., (2005), *Knowledge management in the construction industry: a socio-technical perspective*, Idea Group Inc (IGI).
- McGraw-Hill., (2010), The business value of BIM in Europe. *Getting Building Information Modelling to the Bottom Line in the United Kingdom, France and German*, New York: McGraw-Hill
- McGraw-Hill., (2012), *The business value of BIM in North America: multi-year trend analysis and user ratings (2007-2012): Smart Market Report*. New York: McGraw-Hill
- McGraw-Hill., (2014), *The Business Value of BIM for Construction in Major Global Markets How Contractors Around the World Are Driving Innovation With Building Information Modelling: Smart Market Report*. New York: McGraw-Hill.
- Sabol, L. (2008), *Building Information Modelling & Facility Management*. Dallas, Tex., USA: IFMA World Workplace,
- Stening, B. W., Everett, J. E., (1984), Response Styles in a Cross-Cultural Managerial Study. *The Journal of Social Psychology*, 122, p151-156.
- Vogt, B., (2010), *Relating Building Information Modelling and Architectural Engineering Curricular*. Kansas: Kansas State University.
- Wang, C.C., and Chien, O., (2014), "The Use of BIM in Project Planning and Scheduling in the Australian Construction Industry" ICCREM 2014: Smart Construction and Management in the Context of New Technology, *ASCE*, 14, p126-133.
- Wong, C.-S., Peng, K., Shi, J. and Mao, Y., (2011), Differences between odd number and even number response formats: Evidence from mainland Chinese respondents. *Asia Pacific Journal of Management*, 28, p379-399.